PATENT SPECIFICATION (11) 1361448

1361448

(21) Application No. 41411/71 (22) Filed 6 Sept. 1971

(31) Convention Application No. 7013151 (32) Filed 4 Sept. 1970 in

(33) Netherlands (NL)

(44) Complete Specification published 24 July 1974

(51) International Classification E04C 1/24 5/03

(52) Index at acceptance

E1W 4A16 4A1 4A23 4A40

E1K 1C2

(19)

(72) Inventors GERARDUS PHILIPPUS VAN OVEN
KARL GEORG WILLY PETERS and
ALBERT WETHMAR

(54) A PROFILED FLOOR PLATE AND A FLOOR INCLUDING CONCRETE POURED INTO THE PLATE

(71) We, PRINS N.V., a Dutch Company of Randweg 35, Dokkum, Holland, and HOLLANDSE BOUWCOMBINATIE (HOLLAND BUILDING CORPORATION) N.V., a Dutch Company of Scheveningseweg 50, Den Haag, Holland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a profiled steel floor plate to be utilized as a mould and reinforcement for concrete to be poured into the floor plate and to a floor including concrete poured into such a plate.

In forming a floor construction, profiled floor plates function both as moulds for the concrete during the pouring thereof and as reinforcements for the structure formed after the hardening or curing of the concrete. To this end the plates have been profiled to give them one or more trough-shaped corregations to receive concrete.

The profiled plates can only function as a reinforcement if the bond between each plate and the mass of concrete is sufficiently intimate. Thus if the floor construction is subjected to bending, a shearing force will occur between the concrete and the steel plate. If this shearing force becomes too great and the bond between the concrete and the plate is broken, the reinforcing function of the steel plate is lost. This may lead to failure of the floor construction.

With a corrugated floor plate the bond between concrete and plate is increased by the provision of bulging portions or protuberances in the upstanding walls of the corrugations or channels. In this connection, the term protuberances denotes irregularities in the surface of the plate, which may be described as "dents", "depressed portions", or "cockles". Proposals have been made for several shapes and arrangements of the protuberances or bulging portions. In Dutch patent application No. 277,568 several alternative structures having such protuberances are described, such as structures having inclined slot-shaped protuberances, or randomly distributed square or pyramidally-shaped protuberances. Among other arrangements, it is proposed that inclined slot-shaped protuberances be in two parallel rows, in which the protuberances of each of the rows are staggered with respect to one another.

With all such known structures the formation of the protuberances is such that it is expected that there is produced a "wedge-effect" between the concrete and the steel plate whn the floor structure is subjected to bending loads. In this case it is assumed that said "wedge-effect" is needed to retain the concrete within the plate, thus causing a sufficiently firm union of the concrete and steel.

The variety of previously proposed, more or less complicated patterns of such protuberances have been chosen because of the wish to strengthen the bond between concrete and steel, more particularly when the floor structure is under load.

Surprisingly, experiments have proved that even more satisfactory results, as far as the bond between concrete and steel as well as the loading capacity of the floor construction is concerned, may be achieved with floor plates embodying the present invention, as compared with the floor plates known in the art. In this respect, some of these new floor plates have appeared to be no more expensive, and in some instances even less expensive, than the floor plates known in the art.

According to the present invention there is provided a profiled steel floor plate to be used as a mould and reinforcement for concrete to be poured into the plate, the plate having one or more corrugations to receive concrete in each of the upstanding walls of which inward or outward protuberances are provided in two

[*Price 25p*]

rows extending parallel to the axis of the corrugation, the edges of the protuberances being substantially circular in shape, for each wall the rows being spaced apart by 0.3 to 0.9 times the height of the wall, and in each row adjacent protuberances being spaced apart by 0.25 to 1.5 times the said height of the wall.

This arrangement of the protuberances may be applied to steel floor plates in a simple way and at low cost. It should be noted that theory suggests that there can be no or little wedge effect produced by the protuberances in such an arrangement. Nevertheless, it seems that because of the very special selection of shape and arrangement of the protuberances, it is possible to cause a bond of equivalent firmness to occur. Experiments have proved that the effect of a "wedge-like" action of the protuberances is difficult to show even for plates with for instance, two rows of tapering slot-shaped protuberances inclined in opposite directions. There are justifiable grounds for doubting the entire effect produced by the "wedge-like" action.

Satisfactory results may be obtained both with protuberances which bulge outwardly with respect to the corrugation and with protuberances which bulge inwardly with respect to the corrugation. However, it has appeared that highly satisfactory results may be obtained if the protuberances protrude inwardly into the corrugation by about 3 mm from the upstanding walls and have diameters of about 10 mm. It is also preferred that the protuberances are arranged in a rectangular pattern. However, satisfactory results can also be obtained if the protuberances of the two rows are staggered in the longitudinal direction of the corrugations.

It appears that when a concrete floor poured in such floor plates is tested, the floor is capable of withstanding a greater bending load than is expected from calculations of strength according to generally used methods for the calculation of strength of reinforced concrete floor structures. It has furthermore appeared that on subjecting said floor to bending, the position of the neutral load plane is at a higher level than expected from classical calculations.

Based on these results, it has been recognized that the floor plate of the invention may be improved to an even further extent. It has appeared that the strength of the concrete floor poured into the floor plate could be increased to an even greater extent if the floor plate is manufactured from a plate material having a thickness of 0.01 to 0.03 times the height of the trough walls, and the yield point (limit of stretching strain) of which, before the plate is profiled, has a value of at least 30 kg/mm². Satisfactory results are obtained with a material having a yield point of about 40 kg/mm², which allows the material to be shaped sufficiently easily while giving a high load-bearing capacity to the floor poured into the plate. It is to be understood that the load-bearing capacity of the floor is also determined by the thickness of the layer of poured concrete, and is dependent also on the height of the corrugation.

The invention also relates to the floors, or portions thereof, which include concrete poured into the profiled steel floor plates of the invention as previously described. It appears that satisfactory results may be obtained if the maximum and minimum thickness of the concrete layer in such a floor, measured in and between the corrugations respectively, are in the ratio of $\alpha:1$, α having a value of between 1.4 and 2.5. With a thickness of the concrete of 4 cm above the summits of the profiles of the floor plates, a value of $\alpha=1.6$ is preferred. If this thickness amounts to 7 cm, however, more satisfactory results are obtained with a value of $\alpha=2.3$.

A characteristic embodiment of a floor plate according to the invention constituting a concrete mould will now be described by way of example with reference to the accompanying drawing. It is remarked, however, that the invention is not limited to this embodiment. Other dimensions, arrangements and patterns of the bulged portions may be used together with other thicknesses of the plates and other heights of the trough-shaped corrugations, as well as a different total height of the concrete layer.

In the drawings:—

Figure 1 shows the concrete mould in a diagrammatic and perspective view;

Figure 2 shows a side wall of the mould of Figure 1 in detail; and

Figure 3 is a sectional view on the line III—III in Figure 2.

The concrete mould 1 consists of a steel plate having a thickness of 1.1 mm, which has been profiled in the way shown in the drawing to provide two parallel trough-shaped corrugations 2 to receive concrete. The corrugations 2 are identical and have flat bottoms and flat upstanding side walls 3 inclined to the vertical and of equal height. In the upstanding side walls 3 of the corrugations are provided hollow protuberances 4, which protude or are bulged inwardly into the space to be taken up by the concrete in the corrugations 2. At its ends, the plate is provided with turned edge portions 5, 6 arranged so that several concrete moulds can be fitted into one another side by side by having one portion 5 engage a portion 6 of an adjacent plate of complementary shape fitting into or around portion 5.

The total height of the mould is about 70 mm and the total width to about 335 mm. The yield strength of the plate (before profiling) is more than 30 kg/mm².

In Figure 2 in which one of the upstanding side walls 3 of a corrugation 2 is shown in a

horizontal side view, it can be seen that the protuberances 4 are arranged in a rectangular pattern. The protuberances are 30 mm, apart in the longitudinal direction of the corrugation and 50 mm. apart the direction transverse to the longitudinal direction. The edge of each protuberance 4 is circular in shape and they have a diameter of 10 mm.

As shown in Figure 3 the protuberances are shaped as convex (part-spherical) discs. They protude about 3 mm from the walls 3.

WHAT WE CLAIM IS:—

1. A profiled steel floor plate to be used as a mould and reinforced for concrete to be poured into the plate, the plate having one or more corrugations to receive concrete in each of the upstanding walls of which inward or outward protuberances are provided in two rows extending parallel to the axis of the corrugation, the edges of the protuberances being substantially circular in shape, for each wall the rows being spaced apart by 0.3 to 0.9 times the height of the wall, and in each row adjacent protuberances being spaced apart by 0.25 to 1.5 times the said height of the wall.

2. A profiled steel floor plate according to claim 1 wherein the protuberances protrude inwardly into the corrugation by about 3 mm from the upstanding walls and have diameters of about 10 mm.

3. A profiled steel floor plate according to claim 1 or claim 2, wherein the protuberances are arranged in a rectangular pattern.

4. A profiled steel floor plate according to any one of the preceding claims, wherein the thickness of the plate is 0.01 to 0.03 times the height of the upstanding walls of the corrugations and the material of the plate, before being profiled, has a yield point of at least 30 kg/mm^2.

5. A profiled steel floor plate substantially as herein described with reference to, and as shown in, the accompanying drawing.

6. A floor or portion thereof, including concrete poured into at least one profiled steel floor plate according to any one of the preceding claims.

7. A floor or portion thereof according to claim 6, wherein the maximum and minimum thickness of the concrete layer above the said floor plate are in a ratio of $\alpha : 1$, in which α has a value of 1.4 to 2.5.

8. A floor or portion thereof according to claim 7, wherein α is 1.6.

9. A floor or portion thereof, including a profiled steel floor plate and concrete poured therein, substantially as herein described with reference to the accompanying drawing.

MEWBURN ELLIS & CO.,
Chartered Patent Agents,
70—72 Chancery Lane,
London, WC2A 1AD,
Agents for the Applicants.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1974.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

fig-1

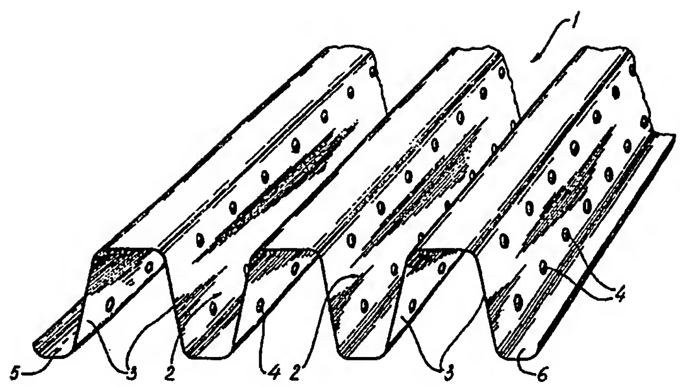

fig-2

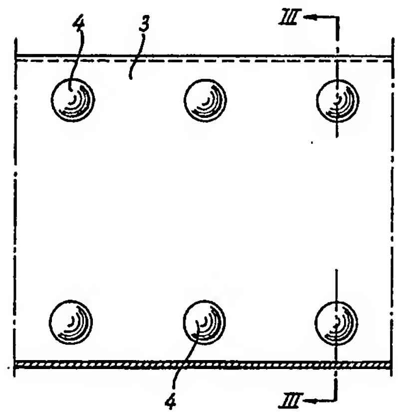

fig-3